

**Principal Investigator:** M. Patrick Feeney

**Title:** Wideband Clinical Diagnosis and Monitoring of the Middle-Ear and Cochlear Function

**MeSH Terms:** middle ear, cochlea, otoacoustic emission

**Objectives:** The translation of a wideband (WB) acoustic test battery to clinical application for middle-ear disorders and the detection of hearing loss due to ototoxicity. The tests measure acoustic responses to sounds presented in the ear canal. The acoustic immittance tests in the battery to assess middle-ear function are an acoustic transfer function (ATF) test and an acoustic reflex threshold (ART) test. The ATF test provides admittance, absorbance and reflectance responses over frequencies important for speech perception (0.2-8 kHz), and is performed either at ambient pressure or as a WB tympanogram. The WB click-evoked or chirp-evoked (CE) otoacoustic emission (OAE) test in the battery assesses cochlear function using an extended bandwidth relative to clinical CEOAE tests.

**Plan:** This research project is part of a multi-center multiple PD/PI NIH-funded study to evaluate the use of new WB tests of cochlear and middle-ear function. The studies conducted at Oregon Health and Science University (OHSU) will consist of two of the specific aims of the parent grant under the direction of Dr. Feeney, the OHSU PD/PI: 1) to use the WB test battery including HF CEOAEs to test for hearing loss in patients receiving ototoxic drugs (Study 1), and to use the WB test battery to assess patients seen for middle-ear surgery (Study 2).

**Methods:** Study 1 is a prospective study comparing changes in HF CEOAE levels with changes in hearing and changes in standard distortion product (DP) OAE levels in patients receiving ototoxic antibiotics for infections. Data from control subjects with normal hearing or sensorineural hearing loss will be used to establish norms and to evaluate test-retest reliability. Subjects will be recruited from the Adult Cystic Fibrosis Clinic at OHSU. The test hypothesis is that the HF CEOAE test performs better than the DPOAE test and pure-tone audiogram at detecting a change in auditory function that signals a concurrent or later change in pure-tone threshold. In a secondary analysis, the performance of the WB ATF and WB ART tests are evaluated for the ability to explain a change in HF CEOAE responses resulting from a change in middle-ear status.

Study 2 is a prospective study examining the WB middle-ear tests and HF CEOAEs in patients who are candidates for middle-ear surgery or surgery for superior semicircular canal dehiscence, which results in a false finding of conductive hearing loss. Data from control subjects with normal hearing or sensorineural hearing loss will again be used to establish norms and to evaluate test-retest reliability. The results of the WB battery will be compared with traditional 226-Hz tympanometry to determine the sensitivity and specificity of the various measures for detecting a specific middle-ear disorder or superior canal dehiscence. Although these studies are conducted at OHSU, analysis of de-identified data may occur at the PVAMC.

**Findings to Date:** Preliminary data analysis for Study 1 has revealed a subgroup of subjects taking ototoxic antibiotics who have excellent hearing thresholds from 250 to 16,000 Hz (40% of subjects), and a second group exhibiting sensory hearing loss in the standard frequency range from 250 to 8000 Hz (4%), the extended range from 9000 to 16,000 Hz (31%) or both ranges (25%). We are in the early stages of data analysis for Study 2.

**Relevance to VA's Mission:** Study 1: Early detection of ototoxicity in Veterans receiving medications for life-threatening infections or chemotherapeutic drugs is a high priority for the prevention of permanent hearing loss. If the WB CEOAE is demonstrated to be successful in detection of ototoxicity in patients with cystic fibrosis who may have robust OAEs, the next step would be to apply this technique to a Veteran population where the strength of OAEs is more varied due to previous noise exposure and age. Study 2: The accurate diagnosis of middle-ear disorders is critical to planning treatment for Veterans with conductive hearing loss, and for ruling out other disorders such as superior canal dehiscence which can masquerade as conductive hearing loss. Early studies have suggested that WB ATFs may be more sensitive to middle-ear disorders than current clinical tests such as 226 Hz tympanometry. Results from this study will be directly applicable to a Veteran population, and follow-up studies are planned.